



**A** CWA *Power*  
**S A S A K U R A**

A CWA POWER  
S A S A K U R A

Regional Leader as Seawater  
Desalination Solution Provider



## Vision

Regional Leader as Seawater  
Desalination Solution Provider.

## Mission

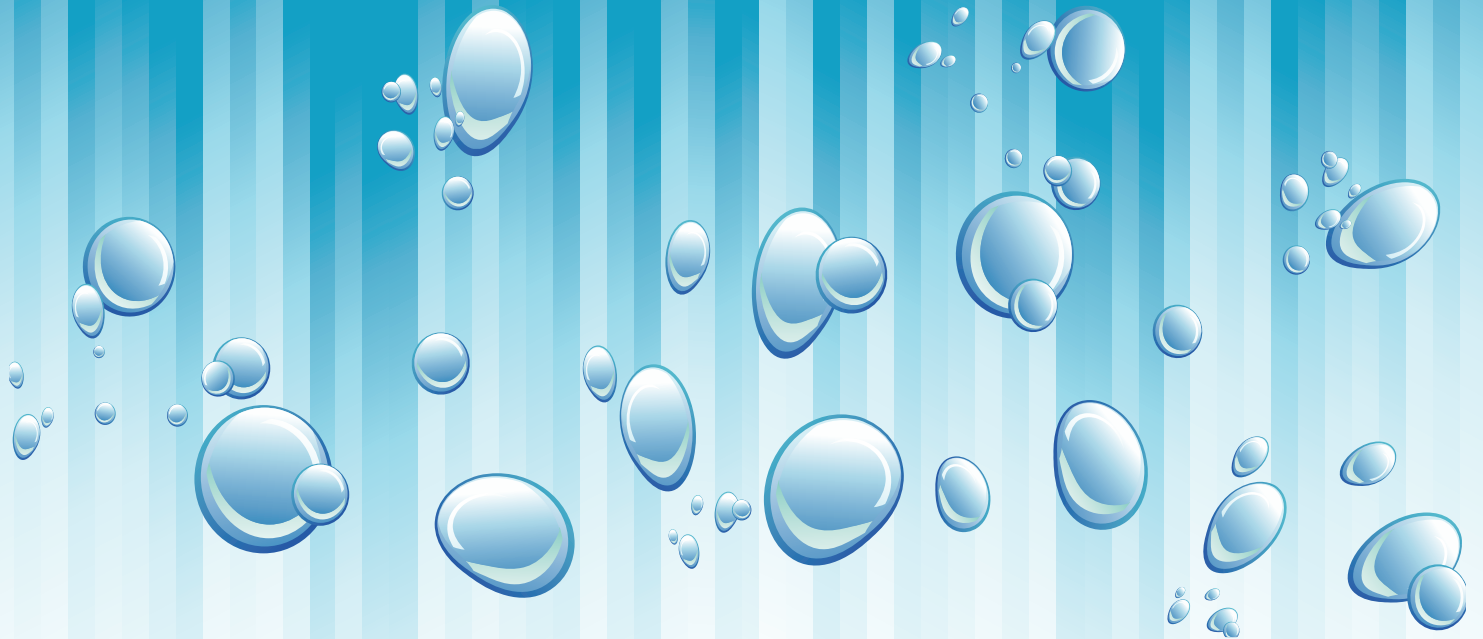
To be the preferred Desalination  
EPC Contractor in the Middle East.  
Proven Leader in Rehabilitation &  
Extension of Service Life for  
existing Desalination Plants.





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Regional Leader as Seawater  
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**EPC PROJECTS**

**DESALINATION TECHNOLOGY**

**M CWA POWER  
SASAKURA**

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## INTRODUCTION

### ARABIAN COMPANY AND SASAKURA FOR WATER & POWER

One of the leading and dynamic companies in the field of DESALINATION Technology.

We are proudly offering our know-how and extensive experience to all the desalination corporations in the world.

#### **The company AIMED to provide:**

- E:** Engineering, Procurement & Construction of new desalination MED & RO projects.
- R:** Rehabilitation of the installed desalination plants.
- C:** Consultancy & Engineering services.
- S:** Supply of spare parts.

APS is keen to contribute largely and effectively to the economic, social and cultural development, helping the community to resolve the shortage of potable water, which is one of the biggest challenges the world is facing.

**THE LEADER IN  
DESALINATION  
TECHNOLOGY**

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e-mail: [aps@acwasasakura.com](mailto:aps@acwasasakura.com)

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# MED DESALINATION TECHNOLOGY

## How Does MED (Reheat Desal) Unit Work?

- The combination of the multi-effect and thermo compression process to achieve high efficiency desalination.
- Heated seawater is sprayed onto the top of the tube bundle of each effect and descends as a thin film over the outside of the tubes.
- Vapor flows inside the tube, where it condenses to form distillate water. As the vapor condenses inside the tubes, it heats up the seawater film on the outside of the tubes and causes this film to boil, thereby generating a new supply of vapor, which is introduced to the next effect.
- Each successive effect works at a lower temperature than the one before.
- The condensation and evaporation process is repeated from the hottest to the coolest effect.
- The number of effects is selected depending on the capacity and thermal efficiency.
- The vacuum in the unit is initially created by a hogging ejector, and then maintained by a vent ejector, which removes non-condensable gases release from the feed seawater in the effect chambers to the atmosphere.





# MED DESALINATION TECHNOLOGY

## LARGEST MED UNITS IN THE WORLD

In response to the growing demand for larger capacity of desalination plants, SASAKURA has developed larger capacity plants up to 20 MIGD (90,920 T/D) MED plants.

Since 2009 Sasakura has started a prototype test of the big tube bundle of 8-MIGD, 10 MIGD, 15 MIGD & 20 MIGD MED units capacity in Sasakura Techno Plaza in Osaka in order to verify the actual heat transfer coefficient of the tube bundle and the actual pressure loss of the vapor generating in the same tube bundle and releasing to the next effect.

### The main features of the largest MED unit:-

1. Highest reliability and performance.
2. Greater production with better water quality.
3. Lower steam consumption.
4. Simple operation and maintenance.
5. Higher temperature operation and higher concentrations.
6. Higher energy efficiency which indicates as higher gain output ratio (GOR).



# MED DESALINATION PROJECTS

## NEW SATELLITE MED PLANTS PROJECT

**Al-Wajh, Ummlujj, Rabigh, Al-leeth, Qunfudaa and Farasan.**

Project Value : 873,927,826 Saudi Riyals  
Started : March 2006  
Ended : November 2010  
Owner : Saline Water Conversion Corporation (SWCC).

### Scope of Work:

Engineering, Material and Equipments Procurement, Erection and Installation, Testing and Commissioning of all equipment in terms of Turn-key contract.



**Al-Wajh, Ummlujj, Rabigh,  
Al-leeth, Qunfudaa and Farasan**



# MED DESALINATION PROJECTS

## NEW SATELLITE PLANTS PROJECT

Al-Wajh, Ummlujj, Al-leeth, Qunfudaa and Farasan.

### Main components:

- Sea Water Intake.
- 2 x 4500 m<sup>3</sup>/day MED Units and its accessories.
- (2) Boilers and its accessories.
- Product water Treatment and product water transfer systems.
- Product water tanks (2 x 4500) m<sup>3</sup>.
- Diesel Tanks (2 x 1500) m<sup>3</sup>.
- Electrical transformers and switch gears.
- DCS and instruments air systems.
- Buildings for offices, control, stores, workshops, laboratory.
- Fire fighting system.



**MED Desal Unit**  
**4500 x 2 Units = 9000 m<sup>3</sup>/day**

# MED DESALINATION PROJECTS

## NEW SATELLITE PLANTS PROJECT

### Rabigh Plant

#### Main components:

- Sea Water Intake.
- 2 x 9000 m<sup>3</sup>/day MED Units and its accessories.
- (4) Boilers and its accessories.
- Product water Treatment and product water transfer systems.
- Product water tanks (2 x 9000) m<sup>3</sup>.
- Diesel Tanks (2 x 3000) m<sup>3</sup>.
- Electrical transformers and switch gears.
- DCS and instruments air systems.
- Buildings for offices, control, stores, workshops, laboratory.
- Fire fighting system.



**MED Desal Unit**  
**9000 x 2 Units = 18,000 m<sup>3</sup>/day**



## WORLD LARGEST MED UNIT

### SHOAIBAH PHASE-2 MED EXPANSION PROJECT

Owner : Saline Water Conversion Corporation (SWCC).  
Project Value : 465 Million S.R  
Started : 2015 On Going

#### Scope of Work:

Engineering, Material and Equipment Procurement, Fabrication, Erection and Installation, Testing and Commissioning of all equipment in terms of Turn-key contract of Multi-Effect Desalination (MED) unit, would supply additional 91,200 m<sup>3</sup>/day of potable water.

- 1 x 91,200 m<sup>3</sup>/day MED Unit and its accessories.
- Steam Transformer.
- Product Water Transmitting Pipeline System.
- Potablization Plant.
- Electrical Transformers and Switchgears Equipped with Deluge Fire Protection System, Fire Alarm and Smoke Detectors.
- DCS and Instrument Air System.
- Construction of Buildings for Offices, Control Rooms.
- Fire Protection System.
- Blowdown Piping System.
- Tie-In to the existing Sea Water Intake System.
- Tie-In with existing central Control Room.
- In-Plant Communication System.



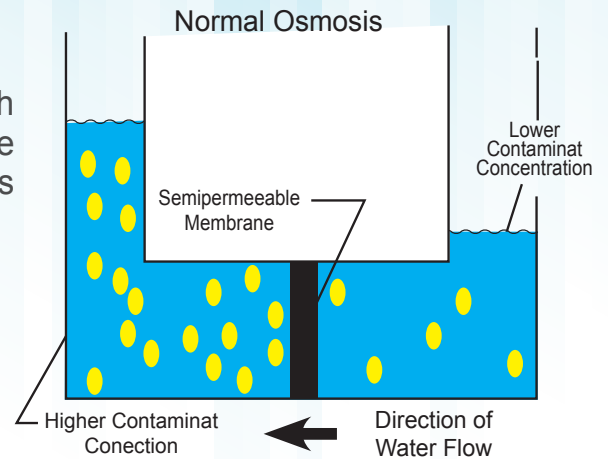
# REVERSE OSMOSIS TECHNOLOGY

## Natural Osmosis:

Flow of solvent from low concentration to high concentration in the presence of semi-permeable membrane creates a pressure called osmosis pressure.

## Osmotic Pressure (equilibrium pressure):

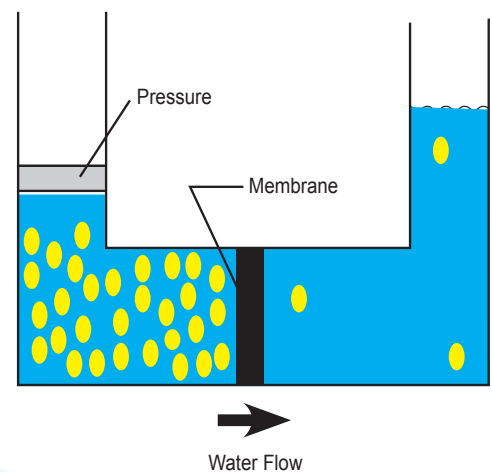
Pressure required to stop natural osmosis, its cohesive force between the solvent and solute.



## Reverse Osmosis:

Flow of solvent from high concentration to low concentration by applying pressure.

## Reverse Osmosis



# REVERSE OSMOSIS TECHNOLOGY

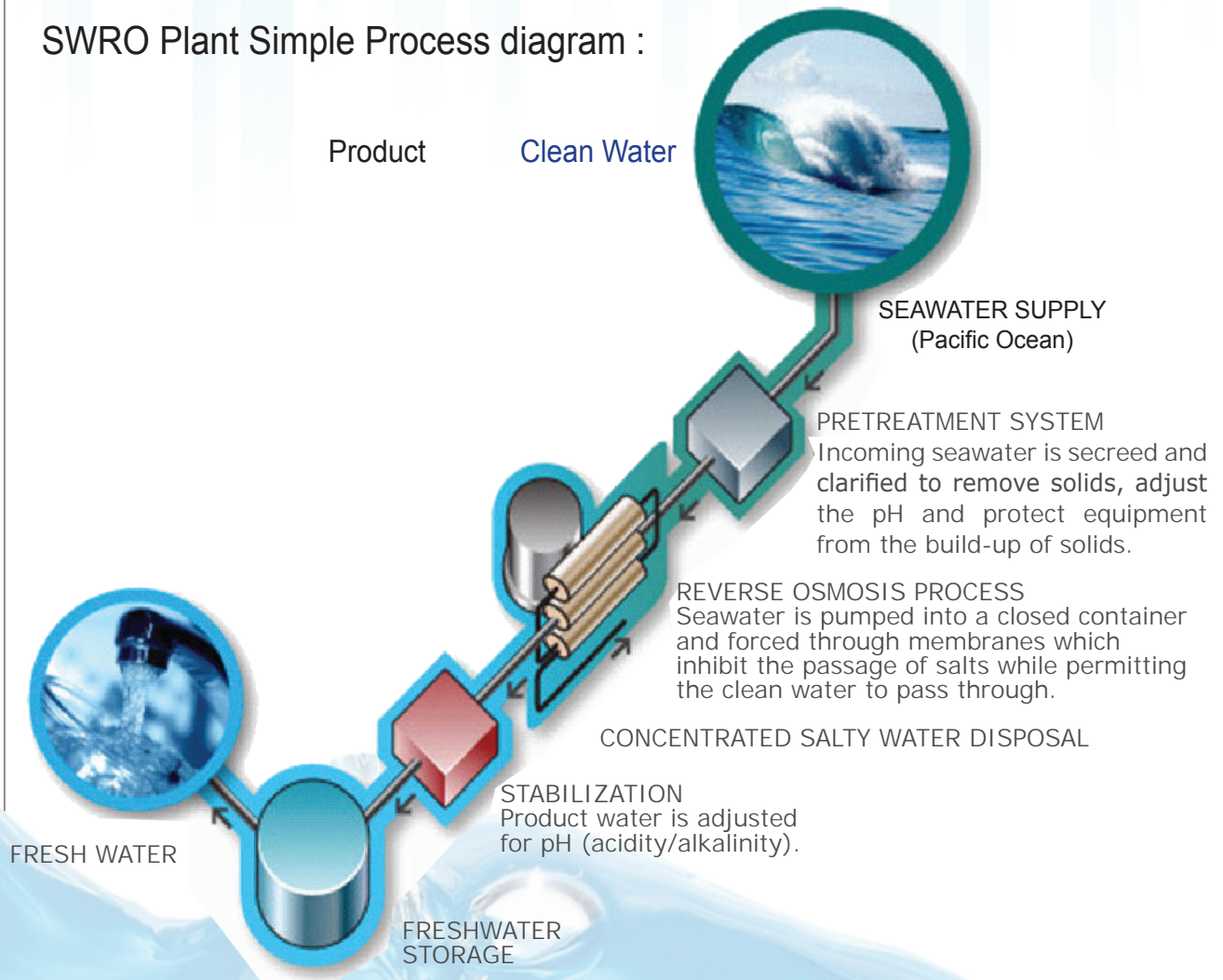
It's also called hyper filtration or molecular filtration

Feed  
Raw Water

- Micro-organisms
- Brine SS
- Organic compounds
- Most dissolved molecules
- Salinity



SWRO Plant Simple Process diagram :





## RO MEMBRANE

### RO Memerance Characteristic:

- Slightly permeable to salt.
- Hight permeable to water.
- Flow of large amiunt of feed water.
- Chemically, physically and thermally stable in saline water.
- Strong to withstand high pressure.
- Inexpensive.
- Long and reliable life.



- Synthetic membrane more sensitive than natural.
- Spiral wound is more sensitive than hollow fiber .
- Asymmetric membrane material.
- Cellulose Acetate (Hollow fiber).
- Polyamide (Spiral wound).



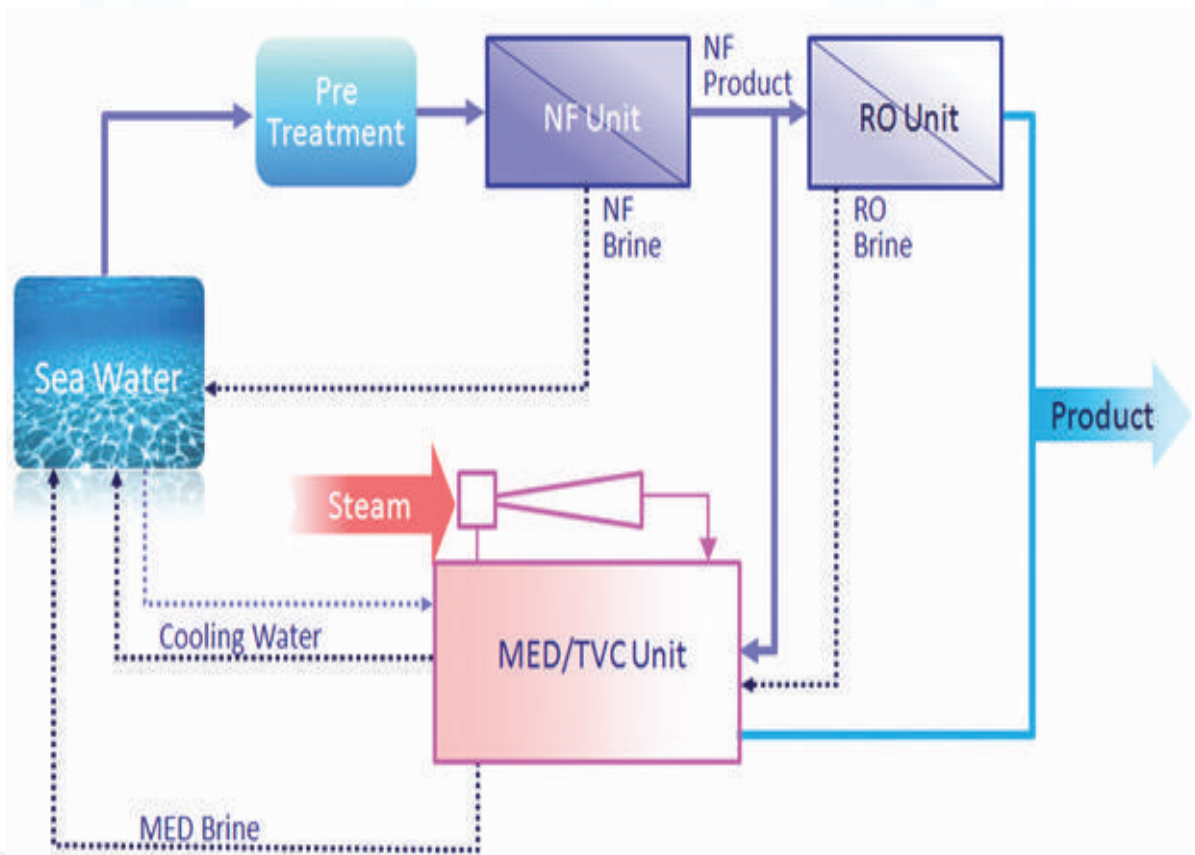
## TRI-HYBRID TECHNOLOGY

### SWDRI Pilot Plant MED/TVC Tri-Hybrid SWCC AI-Jubail

#### Project In Brief :

SWCC-SWDRI, Sasakura and WRPC 'from Japan' have signed a Joint Research Cooperation in order to develop a new type of MED distillation process using tri-hybrid method NF/RO + MED.

NF will reduce the content of sulfate and carbonate salts from seawater. The outlet will be used as feed water to the MED unit. Thus the operating temperature can be raised up to 120C° which increases the MED efficiency without having hard scale problem on the tubes. In this process we also utilize the RO brine (which is free from such salts) as feed to the MED to increase the total system efficiency.



### Tri-Hybrid Schematic Diagram

# TRI-HYBRID TECHNOLOGY

## Advantages of Trihybrid Technology :-

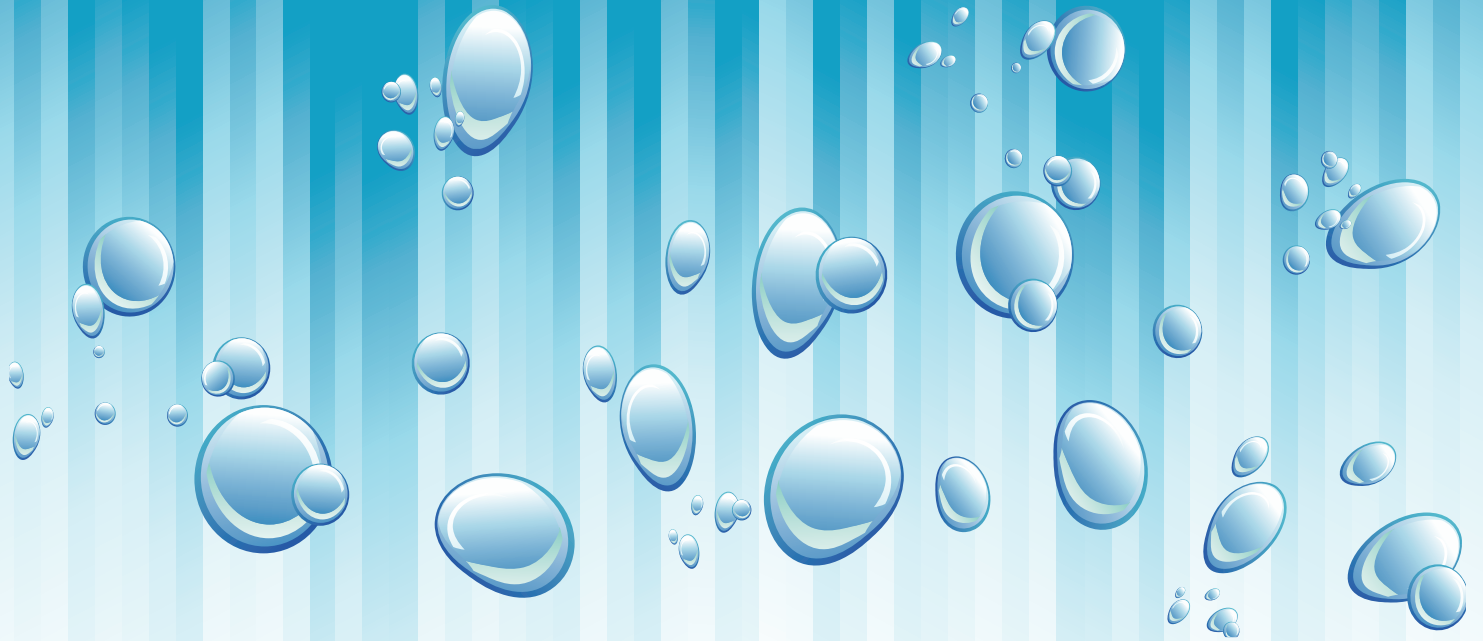
- Steam consumption is 1/3 of steam consumption for conventional MSF or MED desalination plants.
- Sea water consumption is 1/3 of sea water consumption in conventional MSF or MED desalination plants



## Al-Jubail Tri-Hybrid Plant

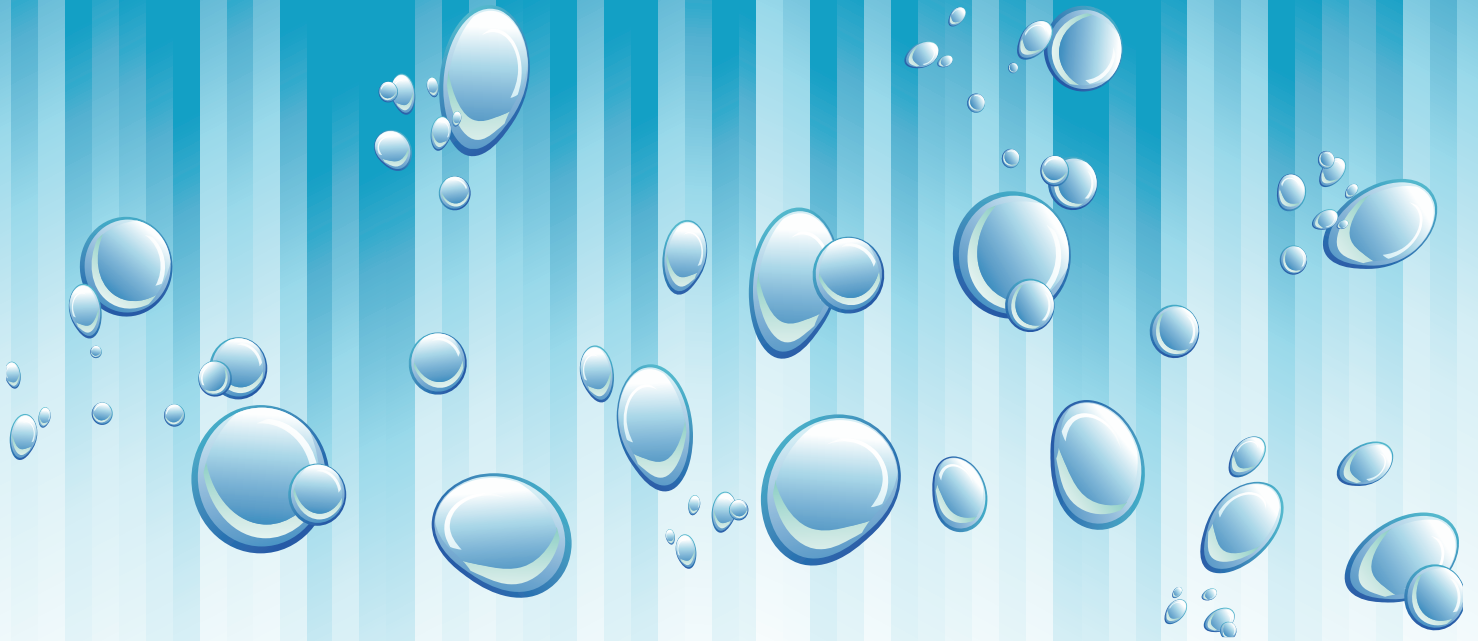
### MED/TVC Pilot Plant

Production	: 24 m <sup>3</sup> /day
GOR	: 3.2-5.5
Number of Effect	: 4
Compression	: Thermal
CTBT Range	: 65-125 deg
Site	: Al Jubail, KSA



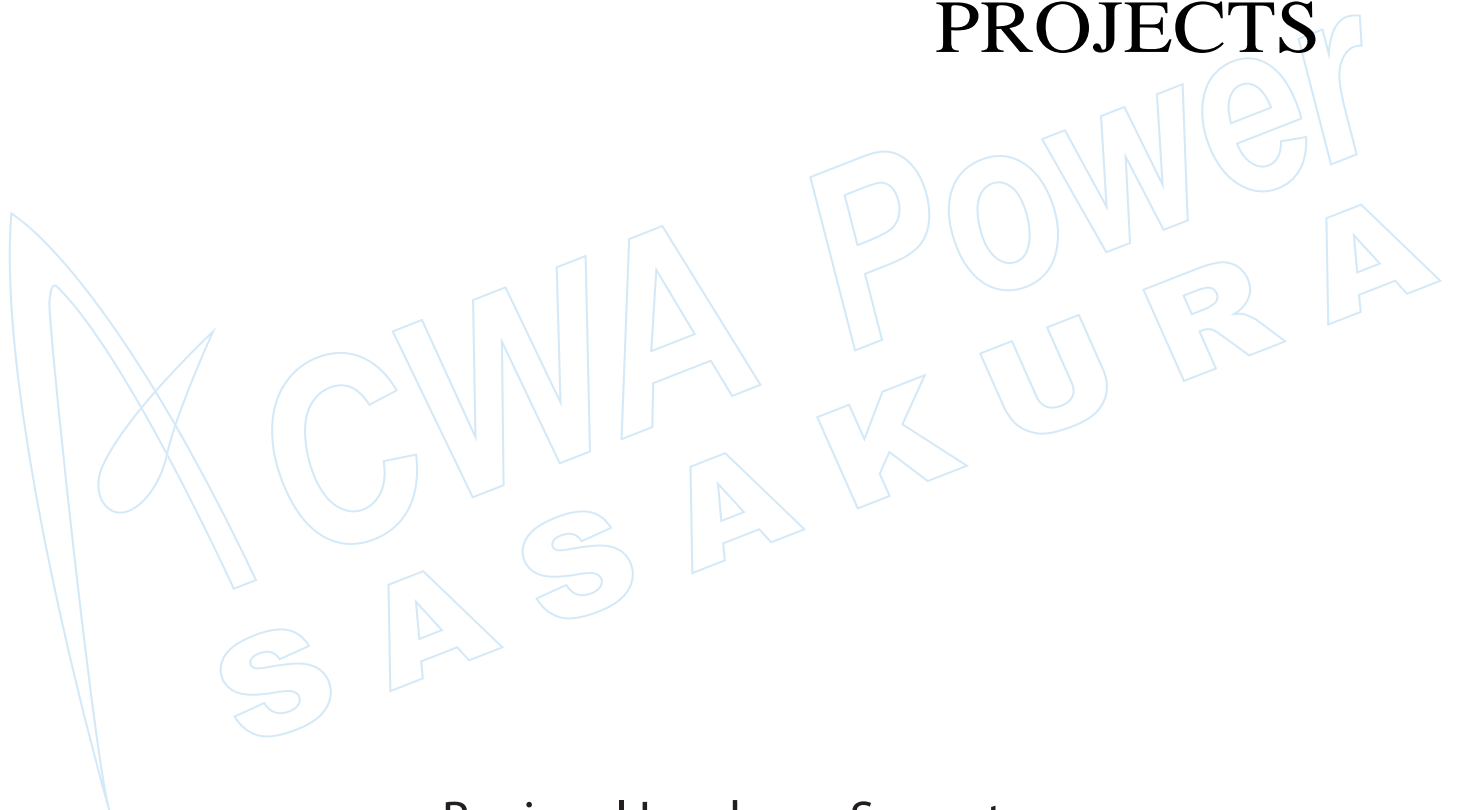
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# REHABILITATION

# PROJECTS



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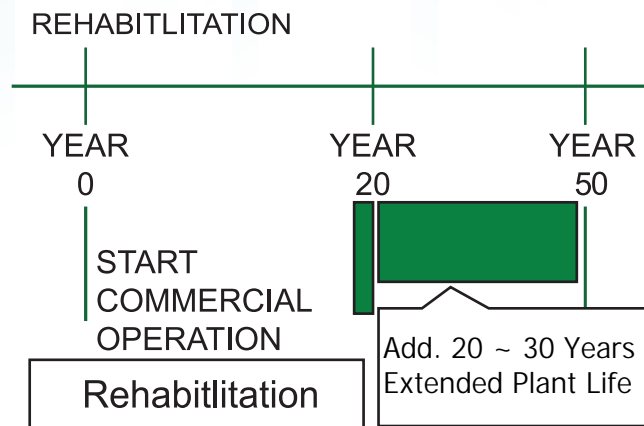
# REHABILITATION & LIFE EXTENTION

## DON'T REPLACE, GO FOR REHABILITATION

**AcWA Power SASAKURA** is a Pioneer Company in Desalination Rehabilitation Projects. Our solution is to refurbish the existing OLD desalination plant and give it a new life.

### SECURED 20 ~ 30 YEARS LIFE EXTENSION

#### What is Rehabilitation



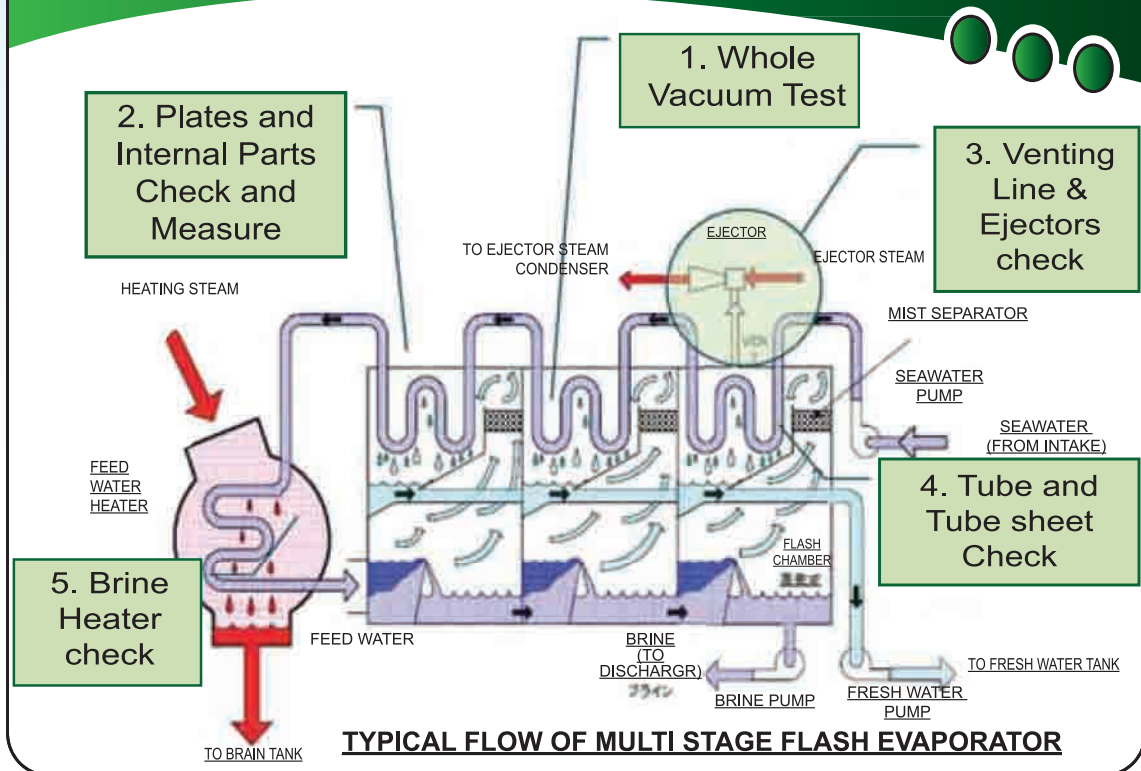
To reach this TARGET of Extending plant life by Rehabilitation, we have to proceed the following 4 STEPS,

- D - Diagnosing
- R - Recommendation
- C - Contract
- E - Execution

**Pioneer Company in  
Desalination Rehabilitation Projects**

# REHABILITATION & LIFE EXTENTION

## Rehabilitation DIAGNOSING



**REHABILITATION** is the best Solution because we will get the benefit of:

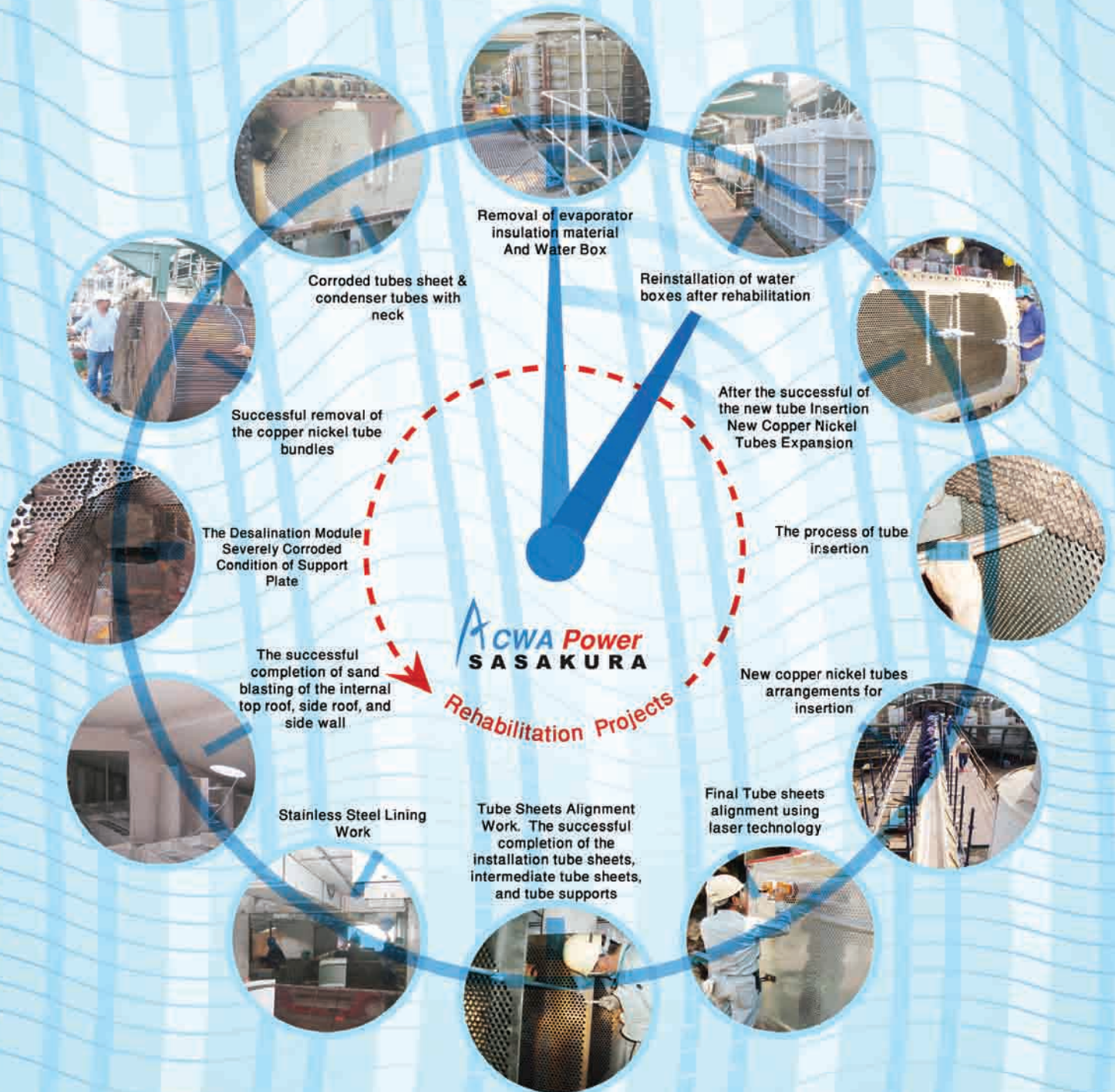
- 1 - **LOW COST** of investment.
- 2 - **MINIMUM TIME** for outage.
- 3 - **INCREASE** of production.
- 4 - **PRESERVING** natural resources.

**REHABILITATION IS BEST SOLUTION**



# CWA Power SASAKURA

## REHABILITATION & SERVICE LIFE EXTENTION



APS REHABILITATION CAN GUARANTEE  
20 ~ 30 YEARS PLANT LIFE EXTENSION



# REHABILITATION PROJECTS

## SWCC Jeddah Plants Phase-4 Rehabilitation Project

Project Value	: 221,900,000 Saudi Riyals
Period	: 30 Months
Started	: Dec 2004
Ended	: June 2007
Owner	: Saline Water Conversion Corporation (SWCC). Jeddah Power & Desalination Plants
Unit Capacity	: 22,710 m <sup>3</sup> /day x 10 Units.
Type of Evaporator	: MSF Type.

### Project in brief:

Jeddah-4 Desalination Plant Rehabilitation Project is considered the benchmark of this new technology that will extend the plant life by extra FIFTEEN YEARS, sustaining the productivity level and the water quality as per the initial design parameters, at less than 20% of the cost of a new plant.

Jeddah-4 Desalination Plant Rehabilitation Project comprises of two main subsets:

#### First:

Replacing the tubes bundles which are made of 90/10 Copper Nickel Alloy, tube sheets, tube support plates and tie rods in ten of the desalination units of the plant at the cost of One Hundred Eighty One Million Saudi Riyals SR 181,000,000.

#### Second:

Re-designing and replacement of the evaporator venting and vacuum system of these desalination units at the cost of Twenty Eight Million And Six Hundred Thousand Saudi Riyals SR 28,600,000.



## RO REHABILITATION

### SWCC JUBAIL RO Plant Rehabilitation Project

Project Value Total	: 58,270,440 Saudi Riyals
Project Period	: 48 Months
Contract Signing Date	: 01/01/2007 - 1/1/2010 (First two stages)
Ended	: 01/01/2011 - 1/1/2012 (Last stage)
Owner	: Saline Water Conversion Corporation(SWCC).
Plant Capacity	: 90,000 m <sup>3</sup> /day.

#### Project in brief:

Rehabilitation of R.O plant at SWCC - Jubail which includes;

- Replacement of existing membranes by hollow fine fiber membranes for 14 RO trains.
- Modification of DCS logic to comply with new membranes operation process.
- Extension of new chlorine line approx. 600 meters for the new membranes supplied.
- Replacement of SS headers and PVC piping.  
Skid cleaning and painting.

# REHABILITATION PROJECTS

## Rabigh (SEC) Desalination Rehabilitation Project

Project Value	: 18.43 Million S.R.
Project Period	: December 2009 to June 2010.
Contract Signing Date	: 15th March, 2009
Contract Ended Date	: July, 2010
Owner	: Saudi Electricity Company (SEC)
Unit Capacity	: 4,300 m <sup>3</sup> /day x 2 Units.
Type of Evaporator	: MSF Type, Built in 1983.

### Project in brief:

Rehabilitation of two units with ECT tube thickness measurement of Desal units & Brine heater. The performance and production quantity has increased after rehabilitation and also the thermal efficiency which saves steam and fuel consumption.

The expected lifetime extension for the plant is estimated to be more than 15 years under normal operation & maintenance condition.

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## Desalination & Power Plant Rehabilitation

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# REHABILITATION PROJECTS

## SWCC Shoaibah Phase-1 Rehabilitation Project

Project Value	: 222.40 Millions S.R
Project Period	: 36 Months
Contract Signing Date	: 30 April 2011
Contract Ending Date	: Under Progress
Contract Ends on	: 03.06.2014
Expected Handover	: 31.12.2013
Owner	: Saline Water Conversion Corporation (SWCC).
Unit Capacity	: 22,000 m <sup>3</sup> /day x 10.
Type of Evaporator	: Multi Stage Flash Distiller (MSF).

### Project in brief:

The Scope of Works for rehabilitation of these units is to measure each tube thickness by ECT for (10) Desal units plus Brine heater. The total number of tubes to be examined by ECT is around 700,000 tubes. Then replace the defective tubes of which tube thickness is less than 70% of the original thickness. Total numbers of tubes to be replaced are around 230,000 pieces.

Venting system re-designed in order to avoid accumulation of stagnant vent gas to prevent and minimize future tube failures.

The unit thermal efficiency increase over the original design by 10% which saves steam and fuel consumption.



# REHABILITATION PROJECTS

## Venting System Redesign

### SWCC Shoabih Phase-1 Rehabilitation Project

#### Venting System Modification,

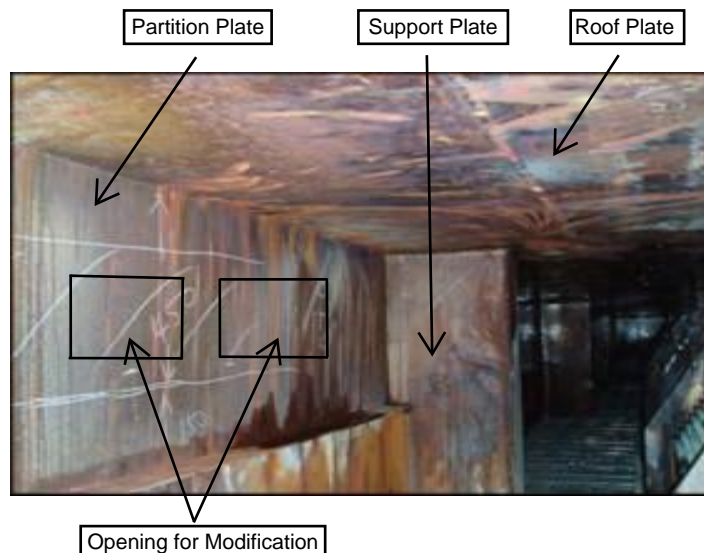
##### I. Actual Defective Conditions due to the defective venting system:

- 1) Corrosion was occurred at the following parts;
  - aa) Evaporator Tubes;  
Outer surface of evaporator tubes were corroded, particularly at the tube supports parts.
  - bb) Evaporator walls, partition plates and distillate through Corroded and rusty.
  - cc) Higher conductivity of distillate water due to the failure of heat exchanger tubes.
- 2) Eventually Higher distillate water conductivity due to the seawater leakage at the corroded parts of evaporator tubes

##### II. Rehabilitation to improve the venting system:

To improve the above defective conditions proven modifications at the venting system were carried out to recover the initial designed conditions, as follows;

- 1) Analysis of existing venting system.
- 2) Design the actual detail modification to eliminate the stagnant area of corrosive non-condensable gases condensable gas etc.
- 3) Carried out actual modification works at site.

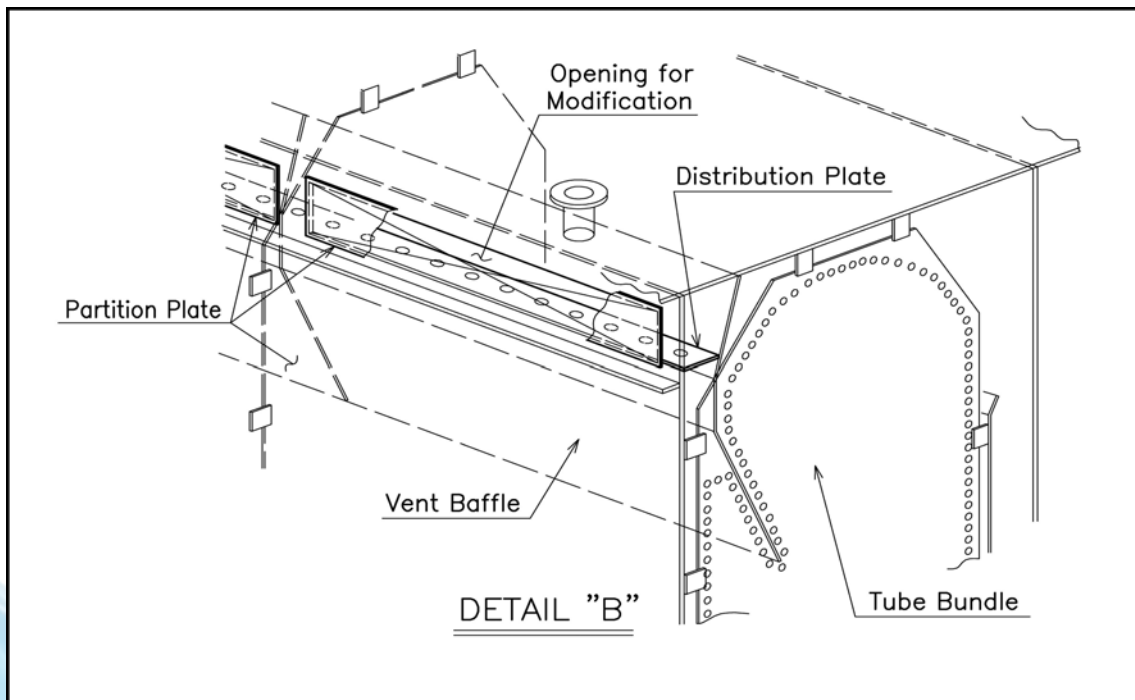
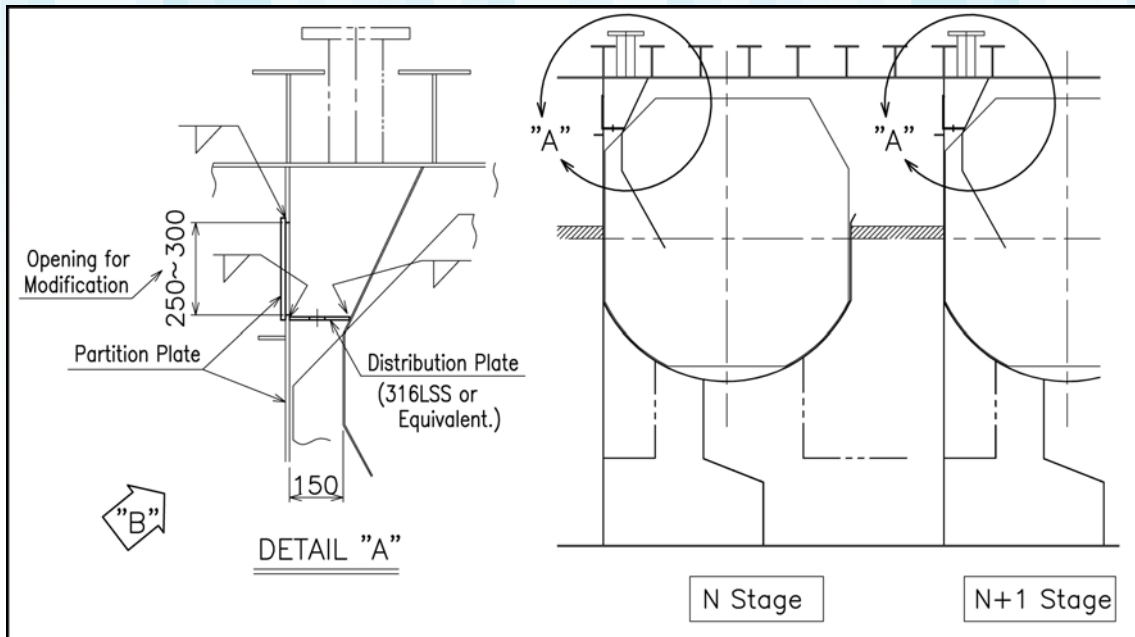


**Location of Modification of Venting System inside Evaporator**

# REHABILITATION PROJECTS

## Venting System Redesign

### Modification of Evaporator Venting System for Shoaiba Phase-1 Plant (Modification carried out as shown in Detail "A" and Detail "B")





# REHABILITATION PROJECTS

## SWCC Jubail-2 C4 Rehabilitation Project (MSF Units: 21 to 30)

Owner	: Saline Water Conversion Corporation (SWCC).
Project Value	: 141,973,691 S.R
Project Period	: 32 Months
Site Handover Date	: 3rd December, 2014
Completion Date	: 3rd August, 2017
Unit Capacity	: 22,000 m <sup>3</sup> /day x 10.
Type of Evaporator	: Multi Stage Flash Distiller (MSF).

### Project in brief:

The Scope of Works for rehabilitation of Evaporator units (21 to 30) is to measure the thickness by ECT for 136,000 tubes of (10) Desal units.

The total number of tubes to be replaced are 64,000 tubes which should have a tube wall thickness less than 70% of its original thickness.

Redesign and modification of the Venting system in order to avoid accumulation of the stagnant non-condensable gases to prevent and minimize future tube failures.

It will enhance the efficiency of the existing MSF units for saving steam and fuel consumption.



## Company Best Performance Award



ACWA Power SASAKURA awarded as the “Company Best Performance” in the Arab world for the year of 2013.

The official announcement of the award and the distribution of trophy and certificate were on Saturday 11th May 2013 after inauguration of the “11th Operation & Maintenance conference in the Arab countries” held in Hilton hotel, Jeddah, KSA from 11th to 14th May, 2013.

The Minister of Municipality Prince Mansoor Bin Mutaeb had given the award to the President of ACWA Power Sasakura Mr. Abdullah Al-Ajmah.





ACWA POWER  
SASAKURA



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ACWA Power Sasakura,  
Maisaloon Street, SWEC Building,  
Opposite Shada Hotel/Appartments.

Al-Hamra District,  
P.O.Box, 1745 Jeddah 21441,  
Kingdom of Saudi Arabia.

Phone: +966-12-6617484  
+966-12-6617496  
Fax: +966-12-6617479

Email: [aps@acwasasakura.com](mailto:aps@acwasasakura.com)

Website: [www.acwasasakura.com](http://www.acwasasakura.com)